MIL-C-1193
14 July 1949

MILITARY SPECIFICATION

COMPASSES, SHIP, NAVY NO. 1, MAGNETIC
(7½-INCH CARD)

This specification was approved by the Departments of the Army, the Navy, and the Air Force for use of procurement services of the respective Departments, and supersedes the following specification:

Navy 18C1d
15 October 1945

This specification consists of this cover sheet and Navy Department Specification 18C1d dated 15 October 1945, attached hereto, without modification.

Copies of this specification may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington 25, D. C., except that activities of the Armed Forces should make application to the Supply Officer in Command, Naval Supply Center, Norfolk 11, Va. Both the title and identifying number or symbol should be stipulated when requesting copies.

When a request for this specification is received by a supplying activity, it will be necessary to attach this cover sheet to the pertinent specification before issue.

18C1d
OCT. 15, 1945
SUPERSEDING
18C1c
Feb. 1, 1944

NAVY DEPARTMENT SPECIFICATION

COMPASSES, SHIP, NAVY NO. 1, MAGNETIC (7½-INCH CARD)

A. APPLICABLE SPECIFICATIONS AND DRAWINGS.

A–1. *Specifications.*—The following specifications, of the issue in effect on date of invitation for bids, form a part of this specification, and bidders and contractors should provide themselves with the necessary copies:

Navy Department specifications:
General Specifications for Inspection of Material.
39P16—Packaging and Packing for Overseas Shipment:
Section V—Boxes, Wood, Cleated, Plywood (JAN–P–105).
Section VI—Boxes, Wood, Nailed (JAN–P–106).
Section VII—Boxes, Wood, Wirebound (JAN–P–107).
Section XXV—Barrier-Materials, Waterproof, Flexible (JAN–P–125).
Section XXXII—Crates, Unsheathed, Wood, Nailed (JAN–P–132).
66S3—Shockproof-Equipment, Class HI (High-Impact); and Tests for

Army-Navy Aeronautical specification:
AN–C–116—Compass Liquid, Aircraft.

A–2. *Drawings.*—The following Bureau of Ships drawings, of the issue in effect on date of invitation for bids, form a part of this specification, and bidders and contractors should provide themselves with the necessary copies:

S2407/533211—Navy No. 1 compass, mark 1, mod. 2, general assembly.
S2407/533212 to S2407/533220, inclusive—Navy No. 1 compass, mark 1, mod. 2.
S2407/533221—Navy No. 1 compass, mark 1, mod. 2, details.
S2407/533222—Navy No. 1 compass, mark 1, mod. 2, box assembly and details.

B. TYPE.

B–1. Navy No. 1 (7½-inch card) magnetic compasses, covered by this specification, shall be of but one type, as hereinafter specified.

C. MATERIAL, WORKMANSHIP, AND FINISH.

C–1. *Material.*—Unless otherwise specified, material for magnetic compasses shall be of the highest commercial grade and quality.

C–2. *Workmanship and finish.*—The compass and all parts thereof shall be of the highest quality workmanship and finish.

D. GENERAL REQUIREMENTS.

D–1. See section E.

E. DETAIL REQUIREMENTS.

E–1. *Design.*—The design shall be in accordance with Bureau of Ships drawings S2407/533211 to S2407/533222, inclusive. In all design respects not specifically covered by this specification, the compass shall be equivalent to the standard sample (see par. H–3).

E–2. *Performance.*—In all performance respects not specifically covered by this specification, the compass shall be equivalent to the standard sample (see par. H–3).

E–3. All material of the compass, other than the magnets, shall be nonmagnetic.

E–4. The compass fluid shall be in accordance with the requirements of Army-Navy Aeronautical specification AN–C–116 with the following limitations:

(a) The specific gravity at 60° F. shall be not less than 0.745 and not more than 0.770.

(b) The coefficient of cubical expansion, change in unit volume per °F, shall average not more than 0.000560 for the temperature range of −30° F to +160° F.

Between the temperature limits of −30° F and +160° F, the fluid shall neither affect nor be affected by the paint, gaskets, or other materials used in the assembly of the compass.

F. METHODS OF SAMPLING, INSPECTION, AND TESTS.

F–1. *Sampling.*—Before production begins, 2 samples shall be submitted to the Bureau of Ships, Navy Department, Washington 25, D. C., for approval as pilot models. These pilot models will be subjected to tests described in paragraphs F–2 and F–3, respectively. After approval of the pilot samples, all completed compasses shall be subjected to the tests described in paragraph F–3 by the U. S. Naval Observatory, Washington, D. C., before acceptance. In addition to the tests described in paragraph F–3, which shall be conducted on all completed compasses, the tests described in paragraph F–2 shall be conducted by an agent designated by the bureau concerned on at least 1 compass from each group of 100 completed compasses. All instruments, failing to meet the test requirements of paragraphs F–2 and F–3, respectively, shall be rejected and returned at the contractor's expense, and steps shall be taken to insure that all instruments manufactured under this specification shall meet the performance standards.

F–2. *Design tests.*—The following tests cover characteristics, which shall be built into the compass as part of the original design. Such tests will be conducted on all pilot models before acceptance for production and on at least 1 percent random production units, selected in accordance with paragraph F–1. The following tests will be performed by an agent designated by the bureau concerned.

F–2a. *Test procedure.*—The following compass tests shall be performed, in the order listed, at a room temperature of approximately 70° F and in a uniform magnetic field which has a horizontal intensity of

approximately +0.18 gauss and a vertical intensity of approximately +0.54 gauss (such as the earth's field at Washington, D. C.).

F–2a (1). *Swirl.*—The compass bowl shall be rotated through 2 complete turns at the rate of 1 turn in 90 seconds. The total angular departure of the card from its static position shall be not more than 4 degrees either during or after this rotation.

F–2a (2). *Tilt of card under change of vertical magnetic field.*—The card and float assembly shall be subjected to vertical magnetic field intensities of +0.54 gauss and −0.54 gauss. The angular difference in tilt of the North-South axis of the card between these 2 conditions shall be not more than 4 degrees. The test described in paragraph F–3a (3) may be run concurrently with this test.

F–2a (3). *Card tilt.*—When the bowl is tilted a minimum of 14 degrees from the horizontal, and rotated through 360 degrees, the card shall remain free and shall read correctly to within ±1 degree for any static position under such conditions.

F–2a (4). *Magnetic moment.*—The magnetic moment of the assembled magnet array shall be measured and shall be 1600 cgs ±100 cgs units.

F–2a (5). *Vibration.*—The compass, mounted in either a Navy Mark 7 or a Navy No. 1 domehead shelf-type binnacle, shall be subjected to a vibration test consisting of vibrations at various combinations of amplitude, frequency, and sense (clockwise and counterclockwise). These vibrations shall be of a circular translational nature having 3 dimensional components of motion with various amplitudes up through 0.02 inch (diameter) and various frequencies up through 2000 rpm. The card shall remain steady on the pivot and the maximum deviation resulting from any combinations of such vibration conditions shall be less than 5 degrees. There shall be no evidence of damage resulting from extended vibrations under the above conditions.

F–2a (6). *Shock.*—The compass mounted in either a Navy Mark 7 or a No. 1 domehead shelf-type binnacle, shall be subjected to shock tests prescribed in Navy Department Specification 66S3. Any damage shall be within the limits of acceptability as covered by Navy Department Specification 66S3.

F–2a (7). *Salt spray test.*—The compass shall be exposed to a finely divided spray of 20 percent NaCl (by weight) in distilled water at a temperature of 90° F. for 100 hours. The tank shall be constructed of neutral material, such as wood or soapstone, and so designed that the spray shall circulate freely about the specimen without direct impingement thereon. No liquid which has come in contact with the specimen under test shall return to the aspirator to be resprayed. Before being placed in the salt spray bath the subject compass shall be thoroughly cleaned. There shall be no corrosion of any parts of the compass which would affect its serviceability, and, there shall be a negligible deterioration of the finish such as cracking, checking, blistering, softening, whitening, or loss of adhesion.

F–3. *Production tests.*—All completed compasses shall be subjected to the following production tests by the U. S. Naval Observatory, Washington, D. C. At least 1 percent random production instruments, selected in accordance with paragraph F–1, shall be subjected to the tests specified in paragraph F–2.

F–3a. *Test procedure.*—The following compass tests, unless otherwise specified, shall be performed in the order listed at a room tempera-

ture of approximately 70° F, and in a uniform magnetic field which has a horizontal intensity of approximately +0.18 gauss and a vertical intensity of approximately +0.54 gauss (such as the earth's field at Washington, D. C.).

F–3a (1). *Temperature tests.*—The compass shall be inserted, and left for 6 hours, in a chamber which is controlled at a constant temperature of 160° F (71° C), and also in a chamber which is controlled at a constant temperature of −30° F (−35° C). No bubbles shall be formed, the action of the card shall be normal, and there shall be no evidence of leakage or damage which would affect the serviceability of the compass, either during or after these tests. (These tests shall be performed on 5 percent of the production instruments, chosen at random.)

F–3a (2). *Magnet array test.*—The compass shall be subjected to a magnet array test, which consists of introducing a horizontal magnetic field of approximately ½ gauss intensity across the compass, and nullifying this field at the center of the magnet array by another horizontal magnetic field. The resulting horizontal field across the compass, which has zero intensity at the center of the magnet array, shall have a non-uniform characteristic equivalent to that created by the following system of magnets.

F–3a (2) a. A pair of magnets, each 4 inches long and of 1250±10 cgs units magnetic moment, shall be placed in the plane of the compass magnets such that they are parallel to each other on opposite sides of the compass; like poles shall be placed in the same direction, their perpendicular bisectors passing through the center of the compass, and each magnet 7 inches from the center of the compass.

F–3a (2) b. A single magnet, 4 inches long and of 1250±10 cgs units magnetic moment shall be placed in the plane of the compass magnets such that its extended longitudinal axis passes through the center of the compass, and such that the horizontal field so produced at the center of the compass will be equal and opposite to that caused by the above pair of magnets.

F–3a (2) c. The magnets shall be bi-polar and shall not only match each other accurately in magnetic moment, but shall have poles which are of equal strength and equally spaced with respect to their ends. This system of magnets shall be properly aligned and balanced for each compass as follows:

F–3a (2) c (1). First, the compass bowl shall be aligned with 1 lubber-line to compass north. Next, the above magnet system shall be arranged on a template which can be rotated about the compass (the single radial magnet shall be considered as the reference mark). With the template reference mark set to the east position, the radial position of the radial magnet shall be adjusted until the compass again reads north. Next, the longitudinal position of the paired magnets shall be adjusted so that the compass deviations on north and south shall be the same with the template swung to either the north or south position. The radial position of the radial magnet shall again be adjusted so that the compass deviations on east and west shall be the same with the template swung to either the east or west position. (If several instruments are to be tested, the last adjustments of the radial magnet on the east and west positions are the only adjustments necessary for succeeding set-ups.)

E–3a (2) c (2). After so aligning and balancing this magnet system around the compass, the compass bowl shall be kept stationary, the

template moved successively to each 30-degree position about the compass and the deviation observed after allowing the compass card to settle. None of these deviations shall exceed 5 degrees.

F–3a (3). *Card balance.*—The card and float assembly shall be balanced on its pivot so that its East-West axis shall be horizontal within ±1 degree and the North end of the North-South axis shall be depressed not less than 0 degree and not more than 2 degrees in a vertical magnetic field of +0.54 gauss.

F–3a (4). *Bubbles.*—The completely assembled compass shall have no bubbles even after severe shaking, swinging or inversion.

F–3a (5). *Tilt of compass.*—The compass bowl shall be free to tilt at least 25 degrees in any direction, when installed with its gimbal ring in either a Navy Mark 7 or a Navy No. 1 domehead shelf-type binnacle.

F–3a (6). *Motion of card on pivot.*—The card shall evidence no looseness or wobble effects on the pivot when subjected to a severe shaking and rolling motion in the gimbals. After inverting the compass, the float shall readily reseat itself on the pivot.

F–3a (7). *Bowl balance.*—The compass bowl shall be well-balanced when suspended in its gimbal supports.

F–3a (8). *Expansion chamber.*—The expansion chamber shall be filled to a height of ±⅛ inch of that indicated by the temperature filling data which is stamped on the bottom of the bellows.

F–3a (9). *Period.*—After release of the card from ±30 degrees, the time required for 25 degrees (from 25° to 0°) swing shall be not less than 5.5 seconds and not more than 6.8 seconds.

F–3a (10). *Damping.*—After release of the card from ±30 degrees, the first overswing of the card past 0 degree shall be not more than 11 degrees.

F–3a (11). *Friction error.*—When deflected ±1 degree, the card shall return to its original position within 10 minutes of arc.

F–3a (12). *Compass card error.*—The card graduations shall be checked for alignment with respect to the magnetic meridian. No graduation on the card shall be out of alignment by more than 15 minutes.

F–3a (13). *Overall compass error.*—The compass shall be tested for overall alignment by placing it in gimbal supports on a rotatable table. With the table swung successively to the 4 cardinal and 4 intercardinal magnetic headings, the compass error shall be observed for each heading at all 4 lubber lines. No error shall be more than ½ degree.

F–4. *Additional inspections.*—Where other specifications form a part of this specification, unless otherwise specified, sampling, inspection and tests shall be conducted as required in the referenced specification.

G. PACKAGING, PACKING, AND MARKING FOR SHIPMENT.

G–1. *Packaging.*—Unless otherwise specified, the subject commodity shall be securely fastened inside the carrying case by means of the metal guard clips and seats for the gimbal ring trunnions, by corrugated padding under the bowl, and by a sufficient number of pads the exact size of the inside box lid, die-cut to fit over the face, rest on the gimbal ring, and be flush with the face. Additional pads, not die-cut, shall be placed over the face. The compass shall be placed in a minimum 350-pound Mullen test, Style RSC fiberboard box, with the following interior packing:

G–1a. A scored pad ("rat trap") of a minimum 200-pound Mullen test, at least 1 inch in depth to fit the base of the fiberboard box snugly.

G–1b. Four scored pads ("rat trap") of a minimum 200-pound Mullen test corrugated board, at least 1 inch in depth, to fit 4 sides of the containers, flush with the top of the carrying case.

G–1c. A scored top pad ("rat trap") of a minimum 200-pound Mullen test corrugated board, at least 1 inch in depth to fill the fiberboard box in a compact manner.

G–2. *Packing.*—

G–2a. *For domestic shipment.*—Unless otherwise specified, the subject commodity, packaged as described in paragraph G–1, shall be packed without further interior packing, 4 fiberboard boxes in an unsheathed crate conforming to the requirements of Navy Department Specification 39P16, Section XXXII (JAN–P–132). The gross weight shall not exceed approximately 150 pounds.

G–2b. *For overseas shipment.*—Unless otherwise specified, compasses, packaged as described in paragraph G–1, shall be packed 4 fiberboard boxes in cleated plywood boxes, nailed wood boxes, or wirebound boxes, conforming to the requirements of Navy Department Specification 39P16, Section V (JAN–P–105), Section VI (JAN–P–106), and Section VII (JAN–P–107), respectively. Shipping containers shall be lined with a sealed waterproof bag, or its equivalent, made from material conforming to the requirements of Navy Department Specification 39P16, Section XXV (JAN–P–125), for case liners. The seams and closures shall have a strength and water-resistance equal to that of the body material. Shipping containers shall be strapped in conformance with the requirements of the appendix of the applicable box specification.

G–2c. *For domestic or overseas shipment.*—Each container shall be of a uniform size and shall be designed to fit the contents in a compact manner.

G–3. *Marking.*—

G–3a. *Packages.*—Unless otherwise specified, packages shall be marked with the following information completed:

ARTICLE_____
QUANTITY_____
CONTRACTOR_____
MANUFACTURER_____

G–3b. *Shipping containers.*—In addition to the following marking, and any special marking required by the contract or order, shipping containers shall be marked in accordance with the requirements of the latest issue of the Navy Shipment Marking Handbook.

"DELICATE INSTRUMENTS—HANDLE WITH CARE"

H. NOTES.

H–1. Requests, requisitions, schedules, and contracts or orders should contain the title of the specification, the number, and date.

H–2. Requests, requisitions, and schedules should cover the following features:

H–2a. That each bidder shall submit, with his bid, sufficient information in triplicate to enable the bureau concerned to obtain a clear understanding of the apparatus offered before making award of contract. In general, this information shall consist of the following: Plans, photographs, or catalogue cuts, together with descriptive matter

in sufficient detail to show outline, overall and principal dimensions, method of assembly and disassembly, and weight.

H–2b. That not later than 3 months after delivery of the instrument, the contractor shall furnish the Bureau of Ships, Navy Department, Washington, D. C., with 1 complete reproducible set of detail and assembly drawings with nomenclature in sufficient detail to enable ordering of spare parts from them. Drawings shall be in accordance with Bureau of Ships drawing No. 533197, dated 1 April 1945.

H–3. The standard sample may be seen at the Magnetic Compass and Navigational Equipment Section, Bureau of Ships, Naval Observatory, Washington, D. C.

H–4. Copies of Bureau of Ships drawings may be obtained only upon application to the Bureau of Ships, Navy Department, Washington 25, D. C. When requesting, refer to drawing by both title and number.

H–5. Copies of Army-Navy Aeronautical specifications may be obtained upon application to the Bureau of Aeronautics, Navy Department, Washington 25, D. C., except that Naval activities should make application to the Commanding Officer, Naval Aircraft Modification Unit, Johnsville, Pa. Attn: Records Section, Engineering Division. When requesting, refer to specification by both title and number.

H–6. Copies of Navy Department specifications and the Navy Shipment Marking Handbook may be obtained upon application to the Bureau of Supplies and Accounts, Navy Department, Washington 25, D. C., except that Naval activities should make application to the Supply Officer in Command, Naval Supply Depot, Bayonne, N. J. When requesting specifications, refer to both title and number.